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**Testing methods for electrostatic
propensity of woven and knitted
fabrics**

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F r word

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Printed in Japan

Testing methods for electrostatic propensity of woven and knitted fabrics

1 Scope This Japanese Industrial Standard specifies the testing methods for evaluating electrostatic propensity of woven and knitted fabrics.

Remarks : The following standards are normative references to this Standard.

- JIS K 6741 *Unplasticized polyvinyl chloride (PVC) pipes*
- JIS L 0217 *Care labelling of textile goods*
- JIS L 0803 *Standard adjacent fabrics for staining of colour fastness test*
- JIS Z 8401 *Rules for rounding off of numerical values*
- JIS Z 8806 *Humidity—Measurement methods*

2 Classification of tests The tests shall be classified into the following four types, and the suitable one shall be selected out of these four depending on the purpose of test.

- (1) **Half-life measuring method** After the test piece was charged in a corona discharge field, the duration by which this charged electrostatic potential attenuates to 1/2 of its initial value is measured, and this method is suitable for evaluating the attenuation characteristics of static electricity on woven and knitted fabrics, but not for evaluation of conductive fabrics.

Practically, it can evaluate the degree of twining around a body of clothing or becoming dusty condition, but not suitable for evaluating of the troubles caused by discharging because its mechanism of electrostatic charging is different from actual condition.

- (2) **Friction-charged electrostatic potential measuring method** This is the method to measure the electrostatic potential generated by friction of rubbing cloth while rotating the test piece, and is suitable for evaluation of the electrostatic potential occurred when woven and knitted fabrics are rubbed, but not for the evaluation of conductive fabrics because of the smallness of the test piece.

Practically, it can evaluate the degree of twining around a body of clothing or becoming dusty condition, but not suitable for evaluating of the troubles caused by discharging because a tester can constructionally give only low electrostatic potential.

- (3) **Frictionally charged electricity-amount measuring method** This is the method to measure the amount of electricity generated after frictional charging is accumulated by rubbing a test piece with rubbing cloth, and is suitable for evaluation of the amount of static electricity generated by rubbing woven and knitted fabrics that contain conductive fabrics, but not for the evaluation of antistatic finish by after-working because there is no attenuation of the electric charge, and further it has a fault that the rubbing must be manually operated.

Practically, it can evaluate the degree of becoming dusty and the troubles made by discharging.

2

L 1094 : 1997

- (4) **Friction-charged attenuation measuring method** This is the method to measure the electrostatic potential generated after frictional charging was made by rubbing a test piece with rubbing cloth, and is a combined method of the frictionally charged amount measuring method and the friction-charged electrostatic potential measuring method. It can evaluate simultaneously the easiness of generating static electricity and its attenuation characteristics.

Practically, it can evaluate the degree of twining around a body of clothing, becoming dusty condition, and troubles made by discharging.

Remarks : Other than these methods, there are the method to measure surface leakage resistance and clinging measuring method, and they are shown in Informative reference.

- 3 **Test condition** Tests shall be carried out in a laboratory kept at $(20 \pm 2) ^\circ\text{C}$ temperature and under $(40 \pm 2) \%$ relative humidity.

Remarks 1 If tests are carried out under the conditions other than above, it shall be mentioned as in 6.

- 2 Temperature shall be measured by using the Meteorological agency type specified in JIS Z 8806 or Assmann psychrometer, and then the relative humidity shall be obtained according to the humidity table based on Sprung formula.

4 Taking and preparation of sample and cloth for rubbing

- 4.1 **Taking of sample and rubbing cloth** The sample and rubbing cloth shall be taken from the portion of woven or knitted fabrics whose place is apart from the both selvage ends by 1/10 or more of whole width, and is apart at least one meter from its end.

Remarks : Sample or rubbing cloth shall be taken with care not to stain it as far as possible owing to such a measure as wearing white gloves.

- 4.2 **Washing of sample** When washing sample, carry out according to the test method of No. 103 of test method (water washing) separated symbolically in Attached table 1 specified in JIS L 0217, repeat three times the procedures from washing to dewatering, then wash with warm water at $40 ^\circ\text{C}$ for 10 minutes ⁽¹⁾, dewater ⁽²⁾, again carry out this warm water washing and dewatering, and then dry it naturally.

Notes ⁽¹⁾ Wash only sample or rubbing cloth with warm water excluding a loading cloth for bath-ratio adjustment. In this case, adjust the bath-ratio to be 1 to 300 or more, and carry out reservoir rinsing.

- ⁽²⁾ The dewatering tank and its periphery shall be sufficiently washed with flowing water so that the detergent remained on the dewatering tank may not stain the sample or rubbing cloth.

Remarks : When other washing method or times of washings are adopted, or when not-yet-washed sample is tested, the practicing and its conditions shall be mentioned as in 6.

- 4.3 **Warm-water washing of rubbing cloth** When washing a rubbing cloth, similarly to

3
L 1094 : 1997

the method in 4.2, wash with warm water at 40 °C for 10 minutes ⁽¹⁾, dewater ⁽²⁾, again carry out this warm water washing and dewatering, and then dry it naturally.

4.4 Adjustment of sample and rubbing cloth For adjustment of taken sample and rubbing cloth, generally after carrying out the preparatory drying at 70 °C ⁽³⁾ for one hour, leave them as they are under the state of measuring temperature and humidity for at least 24 hours.

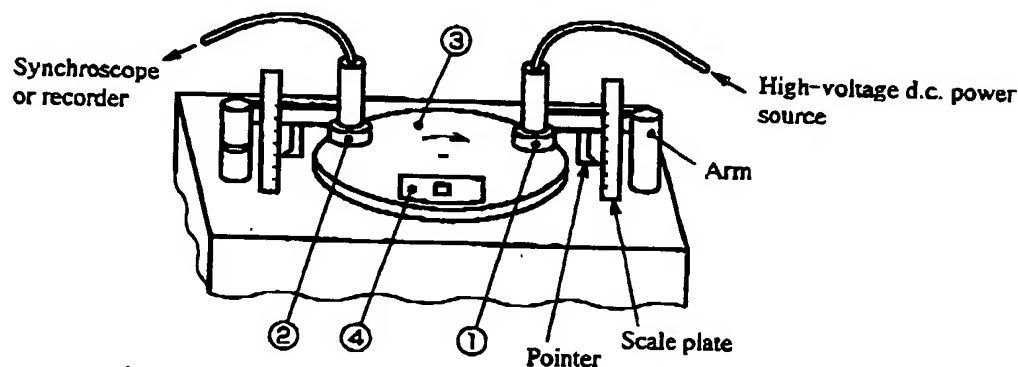
Note ⁽³⁾ In case of taking polyvinyl chloride for sample, it shall be 60 °C .

5 Testing methods

5.1 Half-life measuring method

5.1.1 Apparatus Apparatus shall be as follows.

(1) Half-life measuring apparatus The apparatus shall be composed of an impressing part to charge arbitrarily the test piece, high-voltage d.c. power source for making corona discharge, a turn table to rotate the test piece on it, receiving part to detect potential of test piece, its amplifier, and so on (see Fig. 1).



- ① Impressing part (needle electrode)
- ② Receiving part (diameter of electrode plate : 28 mm ± 0.5 mm)
- ③ Turn table (measuring 200 mm ± 4 mm in diameter, and with at least 1 000 rpm) The distance from the center of the turn table to the center of the impressing part, receiving part, and test-piece attaching frame, shall be 72 mm ± 2 mm each.
- ④ Test-piece attaching frame [inside diameter of the attaching frame for test-piece is (32 ± 0.5) mm × (32 ± 0.5) mm]

Fig. 1 Example of half-life measuring apparatus

- (2) **Recording device** Either synchroscope or recorder.
- (3) **Electricity removing device** Self-discharging-type or potential impressing-type electricity remover.

5.1.2 Operation From the sample at 4, take 5 test pieces measuring respectively 45 mm × 45 mm.

Connect a half-life measuring apparatus with a synchroscope or recorder, elevate the impressed voltage to (+) 10 kV, and adjust ⁽⁴⁾ respectively the distance from the end point of needle electrode of impressing part to the surface of a turn table to 20 mm, and the distance from the electrode of receiving part to the turn table 15 mm. Next, remove electricity on the test piece using an electricity remover, attach it on a attaching frame for test piece with its surface upward, while rotating the turn table impress the voltage of (+) 10 kV for 30 seconds, stop impressing, and while rotating the turn table as it is, measure the duration (s) during which the electrostatic potential will be attenuated to 1/2 ⁽⁵⁾ of its original electrostatic potential. Carry out similar the test on other 4 test pieces.

Test results shall be expressed with the average value ⁽⁶⁾ of 5 test pieces.

Notes ⁽⁴⁾ If the thickness of test piece is seriously thick, adjust the distance from the needle point of impressing part and the electrode plate of receiving part to the one surface of the test piece to be 20 mm and 15 mm respectively, and it shall be mentioned as in 6.

⁽⁵⁾ When the duration needed to make its original electrostatic potential half value is 120 seconds or more, stop measuring when it will reach 120 seconds.

⁽⁶⁾ Round it off to get two significant figures according to JIS Z 8401.

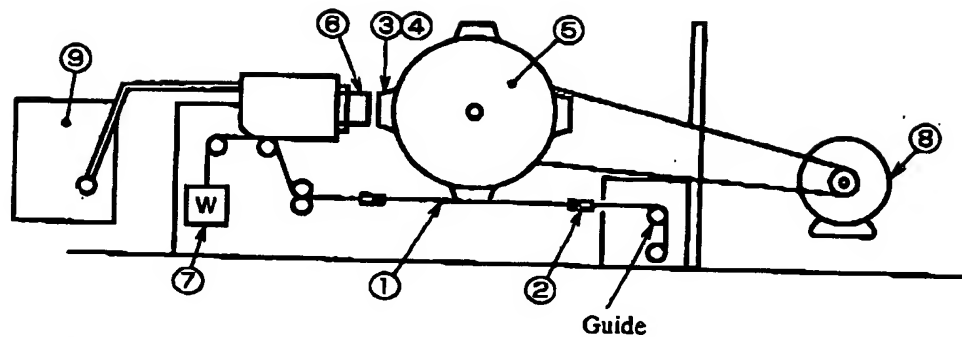
Remarks : For making calibration of half-life measuring apparatus, attach the electrode plate for calibration whose size is the same as test piece to the test-piece attaching place, impress directly on it d.c. arbitrary voltage, rotate turn table, and calibrate the receiving part.

5.2 Friction-charged electrostatic potential measuring method

5.2.1 Apparatus and materials Apparatus and materials shall be as follows.

- (1) **Friction-charged electrostatic potential measuring apparatus** As shown in Fig. 2, the apparatus shall be composed of a rotary drum on which test piece will be attached, friction device by which static electricity will be generated by the friction with a test piece, receiving part to detect generated static electricity, its amplifying part, and so on.

5
L 1094 : 1997



- ① Rubbing cloth
- ② Grip for rubbing cloth (with $25 \text{ mm} \pm 1 \text{ mm}$ in width, and the distance between right and left grips is $130 \text{ mm} \pm 3 \text{ mm}$)
- ③ Attaching frame for test piece (see Fig. 3)
- ④ Holding frame for test piece (see Fig. 4)
- ⑤ Rotary drum (measuring $150 \text{ mm} \pm 1 \text{ mm}$ in outside diameter, about 60 mm in width, and with about 400 rpm of rotation speed)
- ⑥ Receiving part (with $20 \text{ mm} \pm 1 \text{ mm}$ in diameter of electrode plate)
- ⑦ Load (4.9 N)
- ⑧ Motor
- ⑨ Amplifier

Fig. 2 Example of friction-charged electrostatic potential measuring apparatus

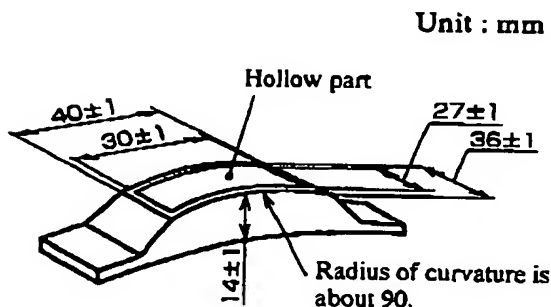


Fig. 3 Attaching frame for test piece

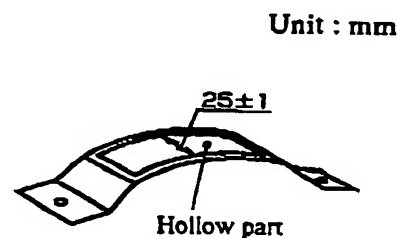


Fig. 4 Holding frame for test piece

- (2) Recording device Oscilloscope or recorder.
- (3) Electricity removing device Self-discharging-type or potential impressing-type electricity remover.
- (4) Rubbing cloth Wool and cotton standard adjacent fabric specified in JIS L 0803. When other rubbing cloth is used, however, the kind of used rubbing cloth shall be mentioned as in 6.

6

L 1094 : 1997

5.2.2 Operation Take test pieces, each measuring 50 mm × 80 mm in size, from the sample shown in 4, by 10 pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction. Further, from the rubbing cloth shown in 4, take pieces of rubbing cloth, each measuring 25 mm in width ⁽⁷⁾ and about 150 mm in length, by 10 pieces for every kind of rubbing cloths.

Connect an oscilloscope or recorder with a friction-charged electrostatic potential measuring apparatus, and adjust the distance between the electrode plate of receiving part and the frame surface ⁽⁸⁾ of test piece attachment to be about 15 mm. Next, remove electricity on the test piece and rubbing cloth using an electricity remover, attach the electricity-removed rubbing cloth at the position of ① of Fig. 2, adjust its height ⁽⁹⁾, apply load of 4.9 N, and fix ⁽¹⁰⁾ the test piece at one place of the attaching frame for test piece so as to make the surface of the test piece get the same level of friction plane.

By means of rotating a rotary drum, rub the test piece, and measure the electrostatic potential given when 60 seconds elapsed after starting rubbing. Changing the test pieces and rubbing cloths, repeat this procedure on 5 test pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction, and then after changing rubbing cloths, carry out the similar procedures.

Test results shall be expressed with average ⁽⁴⁾ of measured values on 5 test pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction with every kind of rubbing cloths.

Notes ⁽⁷⁾ Make the width of rubbing cloth narrower than the hollow part of test-piece attaching frame, contact the rubbing cloth with the test piece, and take it along the direction of warp.

⁽⁸⁾ When the test piece is apparently thick one (such as thick fabrics or raised fabrics), the distance from the surface to be measured of the test piece (in case of raised fabrics, from the top of the fluff) shall be made about 15 mm.

⁽⁹⁾ Under the condition that the test piece is not attached, as shown in Fig. 5, apply 4.9 N of load on rubbing cloth, and at the same time control the height of right and left grips so that rubbing may be smoothly carried out. When the test piece has very large thickness, adjust height of right and left grips with considering its thickness.

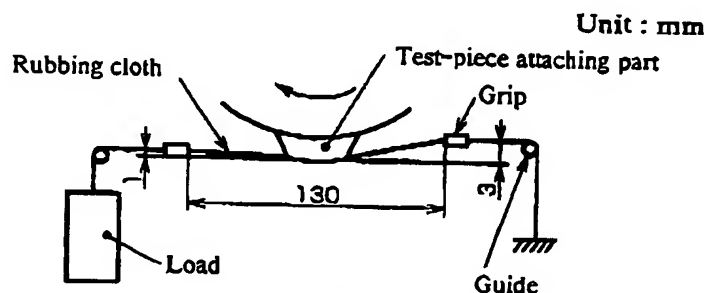


Fig. 5 Adjustment of height of rubbing cloth

⁽¹⁰⁾ When attaching a test piece, stick double coated adhesive tape on the both sides of the test-piece attaching frame, attach the test piece, as shown in Fig. 6, so as to let it lie along curvature of the frame while pulling it as shown by

7
L 1094 : 1997

the arrow marks, and then fix it with a holding frame.

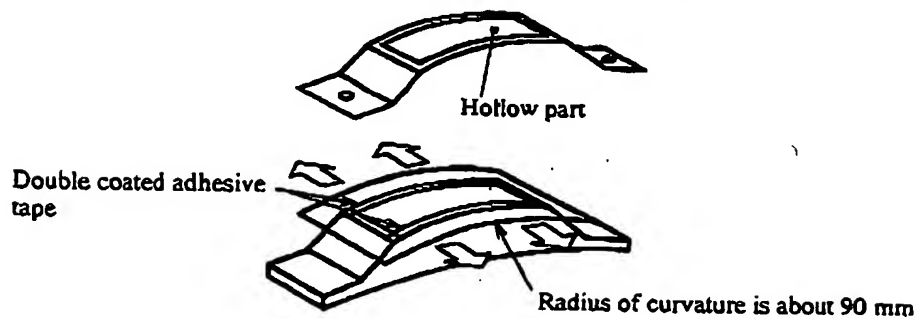


Fig. 6 Attaching of test piece

Remarks : Prior to practicing a series of tests, calibrate a friction-charged electrostatic potential measuring apparatus.

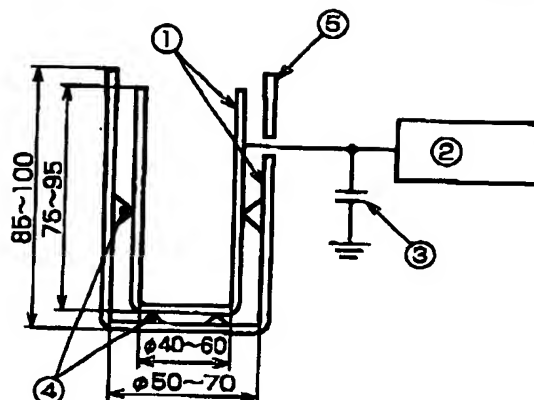
For making calibration, attach the electrode plate for calibration [area of exposed part : $(20 \pm 1) \text{ mm} \times (25 \pm 1) \text{ mm}$] on test-piece attaching place, impress (+) 100 V or (+) 1 000 V of d.c. voltage for calibration on this place, and calibrate the receiving part while a rotary drum is being rotated.

5.3 Frictionally charged electricity-amount measuring method

5.3.1 Apparatus and materials Apparatus and materials shall be as follows.

- (1) **Frictionally charged amount measuring apparatus** As shown in Fig. 7, the apparatus shall be composed of an electrometer, Faraday cage, condenser (capacitor for measurement), and so on.

Unit : cm



- ① Faraday cage (metallic double cylinder with about 0.5 mm thickness)
- ② Electrometer [measurement range DC \pm (10 mV to 10 V) or larger], an oscillation capacity-type electrometer with $1 \times 10^{12} \Omega$ or more in input resistance, or the like.
- ③ Condenser [styrol condenser with 0.1 μ F capacity and with $1 \times 10^{12} \Omega$ or more loss resistance]
- ④ Insulator plate (made of fluororesin, acrylic resin, or polycarbonate resin, having at least $1 \times 10^{12} \Omega$ or more insulation resistance)
- ⑤ Polyester adhesive tape

Fig. 7 Example of frictionally charged electricity-amount measuring apparatus

(2) **Rubbing device** Rubbing device shall be as follows.

- (a) **Rubbing bar** Prepare hard polyvinyl chloride (VP25 specified in JIS K 6741) bar measuring about 400 mm in length, wind it about 5 times with nylon or acrylic rubbing cloth, measuring 500 mm in wale direction and 450 mm in course direction, making the wale direction toward winding direction, and pull both ends and turn them inside of the pipe to fix them.
- (b) **Floor plate** Prepare an aluminum plate measuring 320 mm \times 300 mm in size and 3 mm in thickness, put the rubbing cloth, the same one as that for the rubbing bar, measuring 450 mm in wale direction and 400 mm in course direction, on the plate, wrap the plate with the rubbing cloth covering four sides of the plate, and fix it, as shown in Fig. 8, with polyester adhesive tape with 50 μ m or more thickness and with 20 mm or more width.

9
L 1094 : 1997

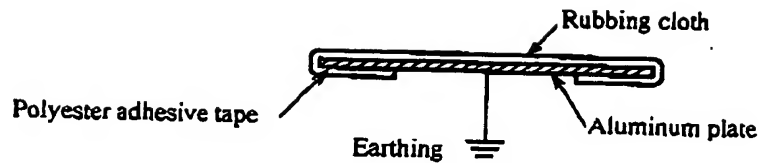
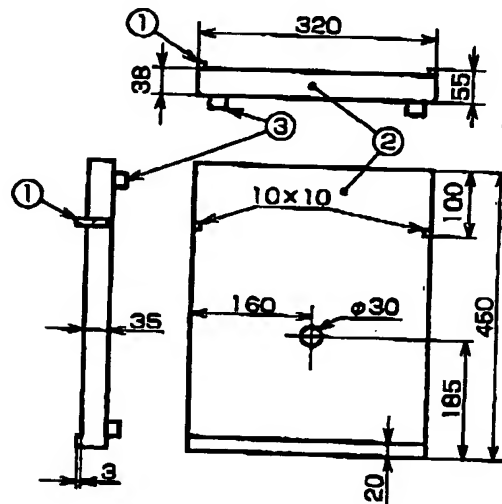


Fig. 8 Floor plate

- (c) **Floor stand** Floor stand shall be wooden stand as shown in Fig. 9.

Unit : mm



- ① Acrylic bar
- ② Wooden plate
- ③ Rubber foot

Fig. 9 Floor stand

- (d) **Insulation bar** Made of acrylic plastics, measuring about 20 mm in diameter and about 500 mm in length.
- (3) **Electricity removing device** Self-discharging-type or potential impressing-type electricity remover.
- (4) **Rubbing cloth** Fabric of nylon or acrylic.

5.3.2 Operation Take test pieces each measuring 250 mm × 350 mm in size from the sample shown in 4, by 3 pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction. As shown in Fig. 10, leaving 260 mm margin at long side end, make sewing the other end as French seam using 10 mm of sewing margin, insert the insulation bar into the place sewed by French seam, put it on the floor plate avoiding to make wrinkles, and then remove electricity from the test piece, floor plate and rubbing bar, using an electricity remover.

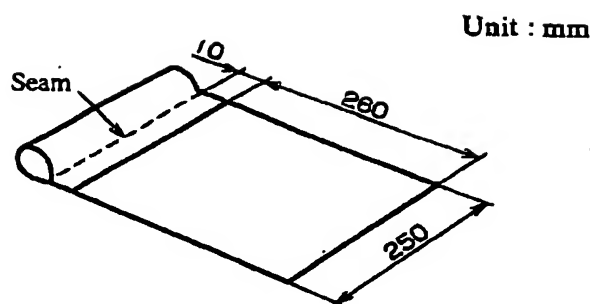


Fig. 10 Sewing up of test piece

Make a short circuit between both ends of the condenser of the frictionally charged electricity-amount measuring apparatus, release it again, hold both ends of the rubbing rod with hands, as shown in Fig. 11, pull the rubbing rod to this side without rotating the rod while the part of tester's weight is being uniformly delivered on it as a load, and try this rubbing procedure 5 times at the rate of one trial per one second.

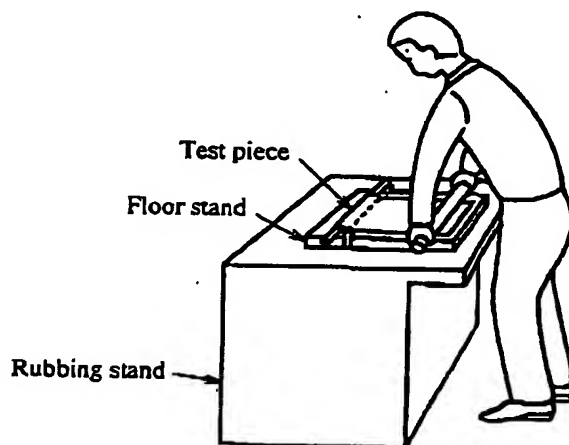


Fig. 11 Example of rubbing procedure

Immediately after rubbing procedure, as shown in Fig. 12, hold one end of the insulation bar, lift up the bar upward to hang the test piece with care not to slide the test piece on the floor plate, peel the test piece during about one second, swiftly throw (") it in a Faraday cage of the frictionally charged electricity-amount measuring apparatus, and measure indicated electrostatic potential (V). Repeat these procedures five times, obtain the average indicated potential (V), and calculate the amount of electrostatic charge per area (C/m²) according to the following formula.

$$\sigma = \frac{CV}{A}$$

- where, σ : amount of electrostatic charge per area (C/m²)
 C : electrostatic capacity of condenser (F)
 V : average indicated electrostatic potential (V)
 A : rubbed area of test piece by rubbing bar (m²)

11
L 1094 : 1997

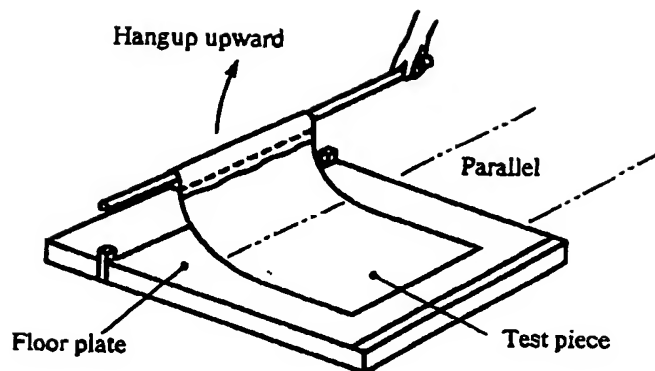


Fig. 12 Direction of peeling

Carry out the above procedures on 3 test pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction. Next, carry out the similar procedures after replacing them with new floor plate equipped with different kind of rubbing cloth and with rubbing bar.

Test results for respectively along longitudinal direction and transverse direction or along wale direction and course direction with every kind of rubbing cloth shall be expressed by the average of amounts of electrostatic charge (C/m^2) for each 3 test pieces, and by the maximum value out of total 12 amounts of electrostatic charge ($^{\circ}$).

Note ($^{(1)}$) During from peeling of test piece to throwing it into Faraday cage, don't make the test piece approach to human body or other objects within 300 mm.

Remarks 1 When test piece in which conductive fibers were equidistantly put as wale-like is tested, sample method might give different results, therefore principally, take test piece in such way as to make the conductive fiber be set at the center of the test piece as shown in Fig. 13.

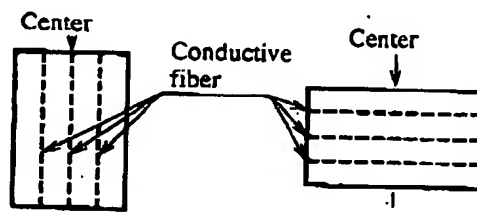


Fig. 13 Taking method of test piece with conductive fibers

2 Generally, the rubbing surface of a rubbing bar shall be shifted a little so as to get new rubbing surface at every trial of test piece. When a whole surface of a circumference is used up, either is necessary, to cut off a part of 5 times wound cloth or to turn its inside out to use new rubbing surface. When rubbing cloth is seriously soiled as in measuring a not-yet-washed test piece, or when measured value is seriously fluctuated owing to oily material, employ new rubbing surface at every trial.

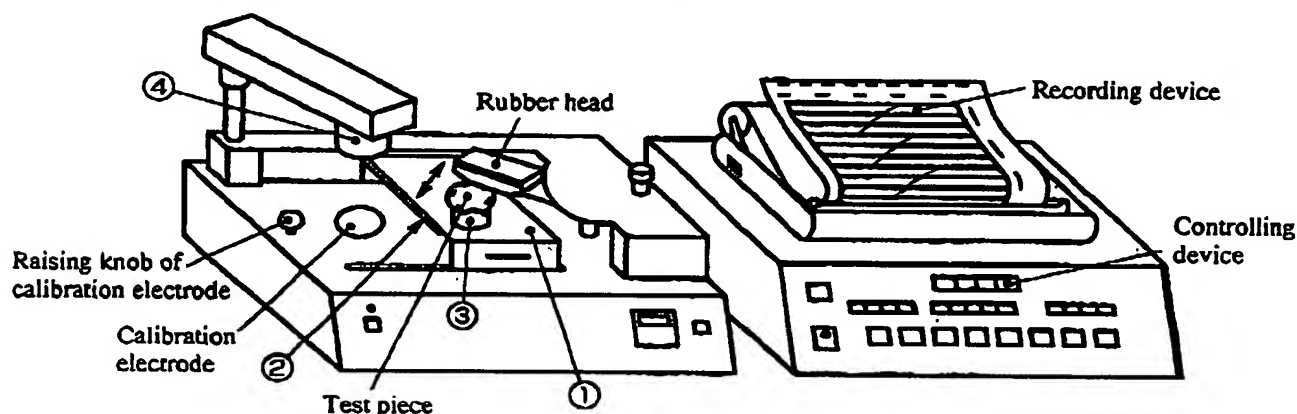
12

L 1094 : 1997

5.4 Friction-charged attenuation measuring method

5.4.1 Apparatus and materials Apparatus and materials shall be as follows.

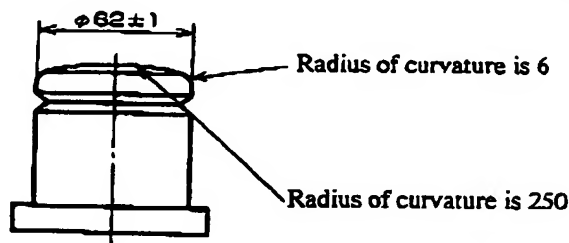
- (1) **Friction-charged attenuation measuring apparatus** As shown in Fig. 14, the apparatus shall be composed of a rubber head, rubbing stand to support the test piece during rubbing, transferring mechanism such as test-piece table to transfer the rubbed test piece right below the receiving part, receiving part for detecting generated static electricity, their controlling device, and recording device.



- ① Table for test piece (with $72 \text{ mm} \pm 1 \text{ mm}$ diameter of hole, and 1.5 mm thick)
- ② Holder for test piece (with $75 \text{ mm} \pm 1 \text{ mm}$ diameter of hole, and 1 mm thick)
- ③ Rubbing stand as shown in Fig. 15 (made of such wood as Magnolia hypoleuca, and its top is adjusted to get 1 mm higher than the upper surface of test-piece table)

Fig. 14 Friction-charged attenuation measuring apparatus

Unit : mm



- ④ Receiving part (rotating sector-type, with 40 mm to 45 mm in effective diameter and $50 \text{ mm} \pm 1 \text{ mm}$ distance to test piece)

Fig. 15 Rubbing stand

- (2) **Calibration device of electrostatic potential** The calibration device of electrostatic potential is as follows.

- (a) **Power source for calibration** D.C. power source having $\pm 5000 \text{ V}$ output voltage.

13
L 1094 : 1997

(b) **Electrode for calibration** As shown in Fig. 16.

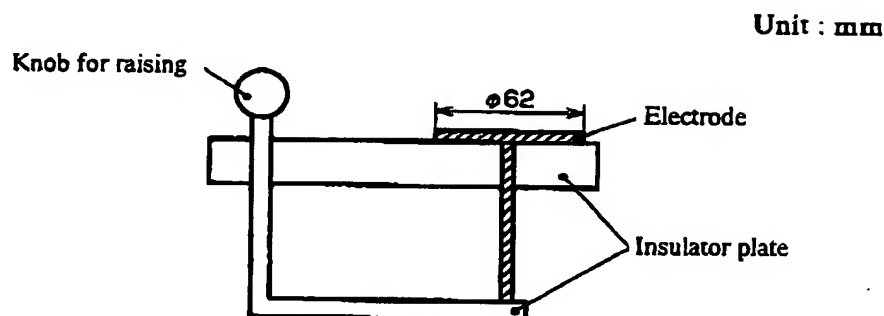


Fig. 16 Electrode for calibration

- (3) **Rubber head** As shown in Fig. 17, it is wood plate measuring 130 mm × 70 mm in size and 17 mm in thickness, covered with cotton cloth (¹²), inside of which absorbent cotton is packed as packing to the shaped like an eraser for blackboard.

Note (¹²) Cotton cloth shall be the specified one in JIS L 0803.

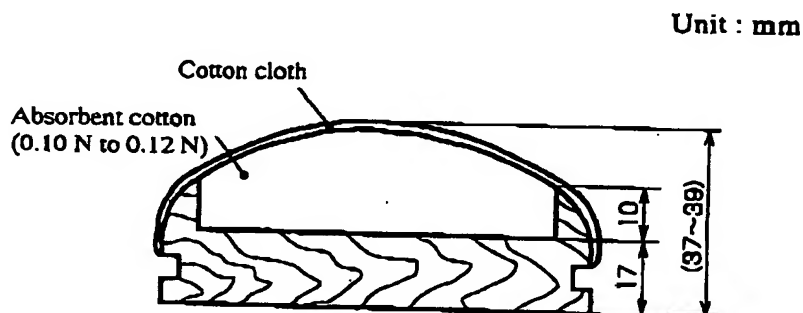


Fig. 17 Rubber head

- (4) **Rubbing cloth** Wool or cotton standard adjacent fabric specified in JIS L 0803. When other rubbing cloth is used, however, the kind of used rubbing cloth shall be mentioned.
- (5) **Recording device** Recorder or recording device having fast response speed (0.3 second or less/full scale).
- (6) **Electricity removing device** Self discharging-type or potential impressing-type electricity remover.

5.4.2 Attaching of rubbing cloth on rubber head Fold twice rubbing cloth transversely (along the weft), cover the rubbing surface of the rubber head with the cloth, and fix it with a rubber band.

5.4.3 Operation From the sample shown in 4, take test pieces, each measuring 120 mm × 100 mm in size, by 3 pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction. Take one rubbing cloth of 300 mm × 300 mm in size from the rubbing cloth at 4. Connect the friction-charged attenuati n measuring

14

L 1094 : 1997

apparatus with a r cording device. Put the table f r test piece under the receiving part, coincide center f circular opening with the center of the receiving part, and make the distance from the receiving part about 50 mm. Attach the test piece on the test-piece holder⁽¹³⁾, and after the test-piece holder is mounted on the test-piece table, remove electricity of the test piece and rubbing cloth with an electricity remover. Run the controlling device, and the following procedures could be carried out automatically. The test piece is transferred to position over the rubbing stand, and the rubbing stand is elevated to support the test piece. As shown in Fig. 18, the rubber head rubs 10 times from this side to other side at the pace of twice per one second⁽¹⁴⁾. After rubbing 10 times, immediately transfer⁽¹⁵⁾ the test piece to lower place of the receiving part, record electrostatic potential and its attenuation curve, and making use of the curve, obtain the initial electrostatic potential (maximum potential) (V) and half-life (s).

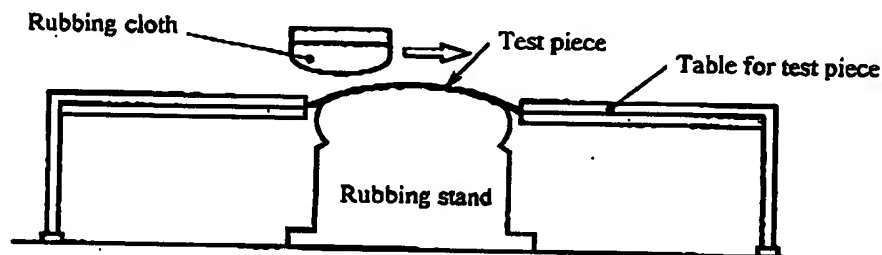


Fig. 18 Rubbing method of test piece

Remarks : The direction for rubbing shall be one direction, that is, from this side to the other remote side.

Carry out the above procedures on 3 test pieces taken respectively along longitudinal direction and transverse direction or along wale direction and course direction. Next, carry out the similar procedures after replacing with different kind of rubbing cloth.

Test results of 3 test pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction with every kind of rubbing cloth shall be expressed by the average⁽⁴⁾ of the values of initial electrostatic potential and of half-life.

Notes⁽¹³⁾ Test pieces shall be firmly attached on a test-piece holder using double coated adhesive tape or cellophane tape, as shown in Fig. 19, to prevent any slackening or wrinkles while rubbing.

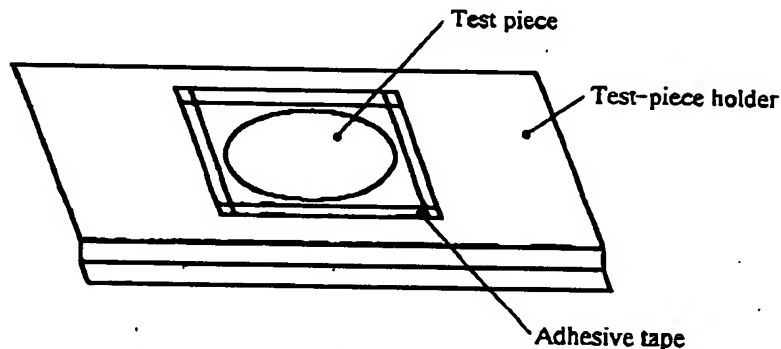


Fig. 19 Attaching f test piece n a test-pi ce holder

15

L 1094 : 1997

- (¹⁴) Friction pressure shall be controlled to the degree that the rubber head gets the dent of about 3 mm depth.
- (¹⁵) Principally, the rubbing cloth shall be turned inside out after its proper side is used three times. When rubbing cloth is seriously soiled as in measuring a not-yet-washed test piece, or when measured value is seriously fluctuated owing to oily material, turn over inside rubbing cloth out and employ new surface of rubbing cloth at every trial.

Remarks : Prior to practicing a series of tests, calibrate the body of a friction-charged attenuation measuring apparatus. For making calibration, draw up the electrode for calibration, instead of a test-piece holder, on the test-piece table, impress (+) or (-) 5 000 V of d.c. voltage for calibration, and calibrate the receiving part.

This d.c. voltage for calibration is high voltage, so be careful not to get electric shock.

6 Test record In the test record, the following items shall be mentioned.

- (1) Type of test
- (2) Test result
- (3) Washing treatment condition
- (4) Type of rubbing cloth (eliminate half-life measuring method)
- (5) Condition of temperature and humidity (only when they are different from specified condition)

Example 1 Half-life measuring method

Half-life	35 seconds
Washing treatment	JIS L 0217 103 3 times
Temperature and humidity condition	25 °C 30 % RH

Example 2 Friction-charged electrostatic potential measuring method

Wool rubbing cloth	Longitudinal	2 500 V
	Transverse	1 100 V
Cotton rubbing cloth	Longitudinal	2 400 V
	Transverse	1 200 V
Washing treatment	JIS L 0217	103 3 times
Temperature and humidity condition		25 °C 30 % RH

Example 3 Frictionally charged electricity-amount measuring method

Nylon rubbing cloth	Longitudinal	Average value 10 $\mu\text{C}/\text{m}^2$
	Transverse	Average value 12 $\mu\text{C}/\text{m}^2$
Acrylic rubbing cloth	Longitudinal	Average value 5.1 $\mu\text{C}/\text{m}^2$
	Transverse	Average value 6.2 $\mu\text{C}/\text{m}^2$
Maximum value Nylon rubbing cloth	Longitudinal	13 $\mu\text{C}/\text{m}^2$
Washing treatment	JIS L 0217	103 3 times
Temperature and humidity condition		25 °C 30 % RH

16

L 1094 : 1997

Example 4 Friction-charged attenuation measuring method

W ol rubbing cloth	Initial electrostatic potential	
Longitudinal	7 000 V	Half-life Longitudinal > 60 seconds
Transverse	5 900 V	Transverse > 60 seconds
Cotton rubbing cloth	Initial electrostatic potential	
Longitudinal	610 V	Half-life Longitudinal 5.2 seconds
Transverse	1 100 V	Transverse 5.0 seconds
Washing treatment	JIS L 0217	103 3 times
Temperature and humidity condition	25 °C	30 % RH

Related standards :JIS G 4305 *Cold rolled stainless steel plates, sheets and strip*JIS L 1023 *Testing methods for several characteristics of textile floor coverings*JIS R 6252 *Abrasive papers*JIS T 8118 *Working wears for preventing electrostatic hazards*

17
L 1094 : 1997

Informative reference Surface-leakage resistance measuring method and Clinging measuring method

Introduction This informative reference specifies, in addition to the testing methods stated in the text, surface-leakage resistance measuring method and clinging measuring method, but does not constitute a part of this Standard.

1 Surface-leakage resistance measuring method

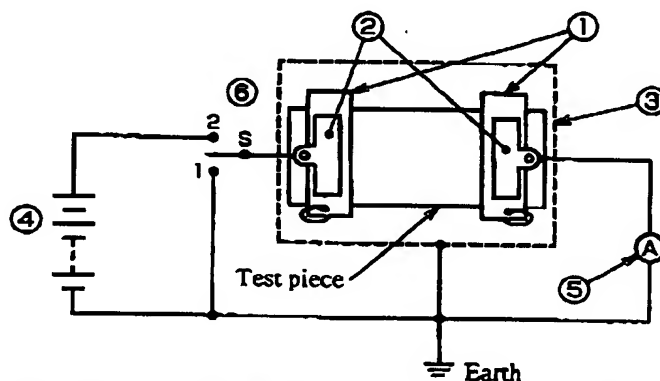
1.1 Condition of test Follow 3 in the text.

1.2 Sampling Follow 4 in the text.

1.3 Washing treatment Follow 4 in the text.

1.4 Apparatus and materials Apparatus and materials shall be as follows.

- (1) **Surface-leakage resistance measuring apparatus** As shown in Informative reference Fig. 1, the apparatus shall be composed of a flat-plate electrode, d.c. voltmeter, d.c. ammeter, d.c. power source, and so on.



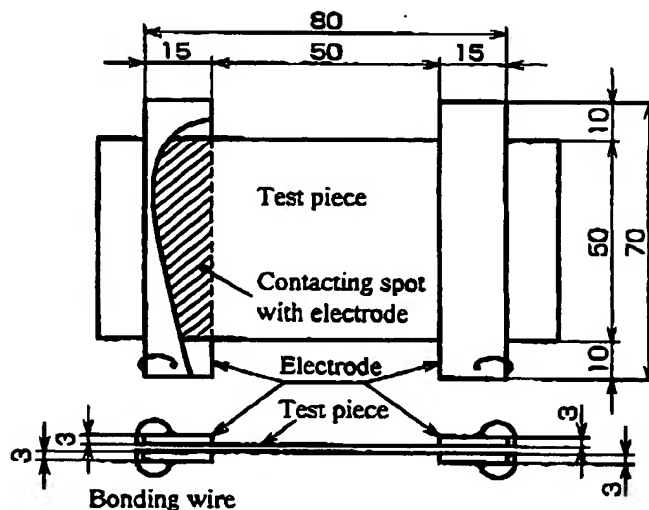
- ① Flat-plate electrode as shown in Informative reference Fig. 2 [two pairs of electrically connected two metal plates measuring about 70 mm in length, (15 ± 1) mm in width, and about 3 mm in thickness, and separated from shielded part by an insulator plate with $1 \times 10^{12} \Omega$ or more insulation resistance]

Informative reference Fig. 1 Circuit diagram of surface-leakage resistance measuring apparatus

18

L 1094 : 1997

Unit : mm



- ② Clip (made of metal having 4.903 Pa or more force to hold the test piece by an electrode)
- ③ Shielding box
- ④ d.c. power source (battery or d.c. stabilized power source having 0 to $\pm 1\,000$ V of output voltage)
- ⑤ d.c. ammeter (picoammeter, electrometer or the equal to or superior to this, and its input cable shall be shielded wire)
- ⑥ Switch

Informative reference Fig. 2 Flat-plate electrode

- (2) **Conductive coatings** Having $10\,\Omega$ or less insulation resistance.
- (3) **Recorder**
- (4) **Electricity removing device** Self-discharging-type or potential impressing-type electricity remover.

1.5 Operation From the sample specified in 4 of the text, take test pieces measuring each 80 mm or more in major side and $50\,\text{mm} \pm 1\,\text{mm}$ in minor side by 3 pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction, apply (') conductive coating on its place contacting with an electrode, remove electricity from the test piece with an electricity remover, and insert the test piece between both electrodes with eliminating any slackening.

Connect the switch S shown in Informative reference Fig. 1 with "1" side, make short circuit between both electrodes for 3 minutes, change the switch S to "2" side, impress d.c. 1 000 V (if the first impressing of d.c. 10 V gives 1×10^{-5} A or more current value after one minute, impressing of d.c. 10 V would be enough), read the indication (A) on d.c. ammeter after one minute, and calculate electric resistivity (Ω) according to the following formula.

Similarly to above, measure each of 3 test pieces taken respectively along longitudinal

direction and transverse direction or along wale direction and course direction.

Test results shall be the average ⁽²⁾ of measured values of 3 test pieces taken respectively along longitudinal direction and transverse direction or along wale direction and course direction.

$$R = \frac{E}{I}$$

where, R : electric resistivity of test piece (Ω)

E : impressed voltage (V)

I : indicated value on ammeter (A)

Notes ⁽¹⁾ Carefully coat lest the coating should ooze out on the place to be measured owing to capillarity.

⁽²⁾ Round it off to two significant figures according to JIS Z 8401.

1.6 Test record Test records shall follow 6 of the text.

Example : Surface-leakage resistance measuring method

Resistance value Longitudinal $7.2 \times 10^7 \Omega$

Transverse $5.1 \times 10^8 \Omega$

Washing treatment JIS L 0217 103 3 times

Temperature and humidity condition 25 °C 40 % RH

2 Clinging measuring method

2.1 Condition of test Follow 3 in the text.

2.2 Taking of sample and of rubbing cloth Follow 4 in the text.

2.3 Washing treatment Follow 4 in the text.

2.4 Apparatus and materials Apparatus and materials shall be as follows.

- (1) **Metal plate for test** Prepare stainless-steel plate ⁽³⁾ measuring about 100 mm × 450 mm in size and about 1.3 mm in thickness, and fold it along about 150 mm line from one side to make 70°, carry out finish treatment of inside upper plate (100 mm × 300 mm) ⁽⁴⁾, and keep it always smooth. Attach a metal clamp at the upper end, and scribe an indicating line at the position 230 mm from the edge of the clamp.

Notes ⁽³⁾ Material shall be SUS 316 specified in JIS G 4305.

⁽⁴⁾ To finish the surface, at first polish with rough abrasive paper, then polish with abrasive paper specified in JIS R 6252, and keep the surface roughness to be about 1.1 μ m or less.

- (2) **Metal clamp** Metal clamp with 70 mm width of grasp.
- (3) **Plate for earthing** Stainless-steel plate with about 200 mm × 350 mm size, with which earth wire is connected.
- (4) **Rubbing plate** Wooden plate, measuring about 50 mm × 150 mm in size and about 65

20

L 1094 : 1997

g in weight, with suitable thickness, of which both sides are stuck with double coated adhesive tape 2 mm in width to fix rubbing cloth.

- (5) **Polyurethane base** Not so hard urethane foam, measuring about 100 mm × 300 mm in size and about 25 mm in thickness.
- (6) **Rubbing cloth** Wool, cotton or acrylic standard adjacent fabric specified in JIS L 0803. When other rubbing cloth is used, however, the kind of used rubbing cloth shall be mentioned as shown in 6 of the text.
- (7) **Removing device of electricity** Self-discharging-type or potential impressing-type electricity remover.
- (8) **Pincette** Its end points or whole body has been electrically insulated.
- (9) **Stop watch** With 0.5 second or more accuracy.

2.5 Attaching rubbing cloth on rubbing plate Attach firmly the rubbing cloth on the rubbing plate so as to coincide the long side of the cloth with the long side of the plate and so that surface of the rubbing cloth may be set as the surface to be rubbed. For fixing firmly, as shown in Informative reference Fig. 3, employ double coated adhesive tape at its side face.

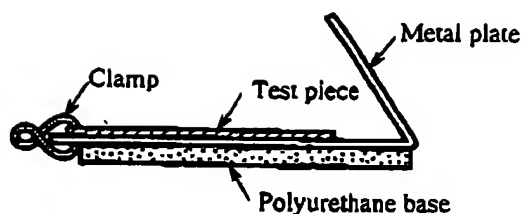


Double coated adhesive tape

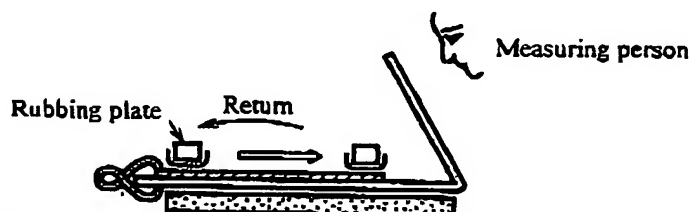
Informative reference Fig. 3 Attaching method by double coated adhesive tape

2.6 Operation From the sample specified in 4 of the text, take test pieces measuring each 75 mm × 230 mm by 9 pieces respectively along longitudinal direction and transverse direction or along wale direction and course direction. From the rubbing cloth specified in 4 of the text, take rubbing cloth measuring 100 mm × 200 mm.

Remove electricity of the sample and rubbing cloth using an electricity remover, and earth the metal plate for test. Attach firmly the test piece to the metal plate for test with metal clamp so as to make the test-piece surface, whose electricity has been removed, face outside (⁵). Then, as shown in Informative reference Fig. 4, put the metal plate for test on the polyurethane base, and rub it 12 times with the rubbing plate on which electrically treated rubbing cloth is fixed, at the pace of one rubbing per one second. When making rubbing, as shown in Informative reference Fig. 5, put the rubbing plate such way that the long side of rubbing cloth makes right angle with the long side of the test piece, and carry out rubbing while middle fingers of both hands are holding both surface edges of the rubbing plate (⁶).



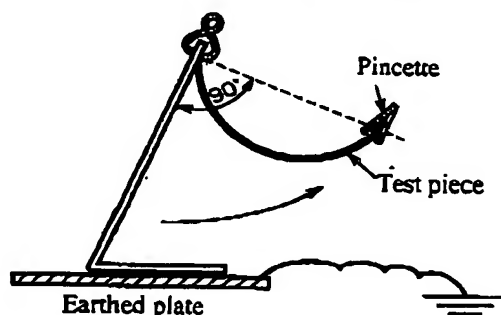
Informative reference Fig. 4 Attaching method of test piece



Informative reference Fig. 5 Rubbing method

After the rubbing procedure, immediately stand the metal plate for test on the earth plate, grip the right lower end of test piece using an insulated pincette, as shown in Informative reference Fig. 6 (') (°), separate the test piece from the metal plate for test for about one second, and let fall the test piece apart from the pincette to be again pulled on the metal plate.

- Notes (°) The lower end of test piece shall be set with indicated line.
- (°) Draw the rubbing plate at one stroke to this side by whole length of the test piece with care so that the load after rubbing will become the weight of the rubbing plate plus rubbing cloth. Next, lift it using thumb and middle finger, and put it back to its original place. Repeat these procedures 12 times.
- (°) Carry out peeling process in such way to draw an arc as shown by the arrow mark in Informative reference Fig. 6.
- (°) During this procedure, attention must be paid lest the breath of measuring person should directly strike the test piece.



Informative reference Fig. 6 Peeling method of test piece

Set free the test piece from the pincette, simultaneously start a stop watch, repeat such procedures that the test piece is peeled for one second after every 30 seconds and then is let be pulled on the plate, and find the duration (s) until the test piece, excluding the place held

22.

L 1094 : 1997

by metal clamp, can be completely apart from the metal plate for test by its own weight (⁹). Carry out these procedures on 3 test pieces taken respectively along longitudinal direction and transverse direction or along wale direction and course direction. Then repeat similar procedures with applying other rubbing cloth.

Test results shall be the average (²) of measured values of 3 test pieces taken respectively along longitudinal direction and transverse direction or along wale direction and course direction, with applying every rubbing cloth.

Note (⁹) If the duration until the test piece can be completely apart from the metal plate for test becomes 300 seconds or longer, stop the test when procedures reach 300 seconds.

2.7 Test record Test records shall follow 6 of the text.

Example : Clinging measuring method

Wool rubbing cloth	Longitudinal	26 seconds
	Transverse	56 seconds
Cotton rubbing cloth	Longitudinal	300 seconds or longer
	Transverse	300 seconds or longer
Acrylic rubbing cloth	Longitudinal	300 seconds or longer
	Transverse	300 seconds or longer
Washing treatment	JIS L 0217	103 3 times
Temperature and humidity condition	25 °C	40 % RH

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